[SUBSTITUTE SPECIFICATION – CLEAN]

QUIET VERTICAL TAKEOFF AND LANDING (VTOL) AIRCRAFT

TECHNICAL FIELD

The present invention relates to manned and unmanned vertical takeoff and landing vehicles. In particular, it relates to a vertical takeoff and landing (VTOL) unusual flying objects (UFOs) having a ducted propellerdisk or series of shrouded impellerdisks for providing zero and low speed horizontal and vertical thrust, and wings with vertical and horizontal stabilizers and air flow vane assembly for providing forward translational lift and thrust in high-speed flight.

BACKGROUND OF INVENTION

There are generally three types of VTOL configurations under current development: a wing type configuration (a fuselage with rotatable wings and engines or fixed wings with vectored thrust engines for vertical and horizontal translational flight), helicopter type configuration (a fuselage with a rotor mounted above which provides lift and thrust) and ducted type configuration (a fuselage with a ducted rotor system which provides translational flight, as well as vertical takeoff and landing capabilities).

There is a long list of related inventions, but the most notable pioneers include the Focke-Wulf Fw61 helicopter in 1936, Piasecki's G-1 tilt rotor in 1951 and Hiller who developed their first flying platform in late 1953 on the basis of a contract with the Office of Naval Research (ONR) for a one-man flying platform. The machine made its first flight in February 1955, and was named the "VZ-1 Pawnee". The Piasecki Air Jeep, described in U.S. Pat. No. 2,282,612, was

developed and flown under U.S. Army and Navy contracts between 1957 and 1962.

In the 1960s Wendell Moore developed the well-known Rocket Belt which can still be seen at various air shows to this day. The VZ-9-AV Avrocar, described in U.S. Pat. No. 3,062,482, was funded by both the US Army and US Air Force and was known for it's disk shape which looked very much like a scaled-up modern "Frisbee" toy. Dr. Moller has contributed several designs, his most notable being his M200x, described in U.S. Patent No. 3,410,507, known for it's flying saucer disk shape and use of multiple engines. This led to his series of small ducted fan UAVs, known as Aerobots, described in U.S. Pat. No. 4,795,111, using a single fan or eight ducted fans, powered by rotary engines. The Airborne Remotely Operated Device (AROD) was a small ducted fan vertical-take-off-and-landing (VTOL) vehicle developed by Moller as a subcontractor to Perceptronics, which was electrically powered, with power supplied through a tether from the ground station. This inspired Helicopter UAVs like the HoverCam which can hover over a fixed spatial point and takeoff and land vertically but have limitations when operating in confined areas due to the exposed rotors rotating above the fuselage.

The Bell/Boeing Eagle Eye Tilt Rotor UAV was a scaled down version and derivative of the Bell/Boeing V-22 Osprey. In 1991 the HOVTOL UAV, described in U.S. Pat. No. 5,890,441, demonstrated twin high power engines capable of both vertical and horizontal flight using ducted fans primarily for vertical lift. Also, the Bombadier CL-327 Guardian VTOL UAV developed in 1996 featured dual, coaxial, contra-rotating, three-bladed rotors. Its design was an evolution of the CL-227 Sentinel, and a follow-on concept, the CL-427 Puma has been proposed. In the late 1980s, Sikorsky Aircraft flew a small doughnut-shaped UAV named Cypher, described in U.S. Pat. No. 5,575,438, that was based on coaxial-rotor technology developed by the company in the early 1970s. The Cyper was clearly a flying platform in general concept. The doughnut-shaped shroud not only improved safety in handling the machine, it also helped increase lift. The Cypher II, described in U.S. Pat. No. 6,270,038, was of similar size to its predecessor, but had a pusher propeller along with its rotor and can be fitted to a configuration with wings for long-range reconnaissance missions.

Other than the electric-motor-tethered AROD built by Dr. Moller, all past VTOLs, manned or unmanned, have used loud fuel-burning engines as the means of propulsion and the weight issues that go with them. What separates all others from the current invention which uses new commercially available light weight quiet low voltage linear induction magnetic bearings similar to those used for monorails. To hover, the MAGLEV monorails require less power than its air conditioning equipment. Most new rollercoasters use LIM (Linear Induction Motor) and LSM (Linear Synchronous Motor) systems, the two variations of electro-magnetic propulsion. They replace a traditional lift hill and do not contain any moving parts. Typically LIM/LSM systems launch the roller coaster from the station extremely quickly, the fastest at 0-100 mph in 7 seconds. The high energy density and rugged design of these motors allows their use in demanding installations requiring high duty cycle, high power, rapid acceleration, improved speed and increased performance. Position sensing and control techniques allow for extremely precise control of acceleration and deceleration to permit the safe transport of sensitive or fragile loads. The lack of moving parts and wearing elements (no brushes or sliding contacts) in these motors greatly increases their reliability.

SUMMARY OF INVENTION

In the present invention, a preferred embodiment of a hover vertical take-off and landing aircraft is made up of 4 primary parts, the top cap of the main body, the propellerdisk (or impellerdisks), the main body (fuselage) and the bottom vane assembly, all built out of a light weight durable composite/plastic. The main cargo area is created by the top cap and the center cone of the main body.

The aircraft uses a magnetic levitation (maglev) bearing system to suspend the propellerdisk (or impellerdisks) between the top cap and the main body at all times. The magnetic bearing system is created by a series of permanent magnet rings, located on the top cap, the propellerdisk (or impellerdisk) and the main body.

A linear induction magnetic power drive is located in the outer edge of the propellerdisk (or impellerdisks), reacting to linear induction actuators located in the main body, which is used to rotate the propellerdisk (or impellerdisks).

Vertical lift in the aircraft is produced by the propellerdisk (or impellerdisks) driving a column of air downwardly, through an annular thrust-flow channel which is formed in the main body of the aircraft.

The annular thrust-flow channel is provided with a flow control vented mechanism at the bottom which is capable of directing the developed air flow in varying orientations between a substantially vertical (axial) orientation for developing stationary, vertical lift (i.e., hovering) and a vectored (angled) orientation for developing a vertical component for producing lift and a horizontal component for producing forward (or rearward) flight.

The aircraft's main body also has an aerodynamic shape which is capable of developing lift responsive to forward flight using fins and rudders.

The power drive runs on light weight batteries, with a variety of optional rechargers, either by paper thin solar panels on the body of the aircraft or an external battery charger, or by linear generators integrated into the support magnets. The battery industry, which is being driven by the electric transportation and portable consumer electronics industries, is making a substantial investment in battery technology. We will closely monitor the state of the art and will utilize the best available technology. Promising technologies include: nickel metal hydride, lithium-ion, and zinc-air.

Unmanned surveillance aircraft will use a standardized teleoperation system (STS) & standardized robotic system (SRS) to control flight & manage audio/video information. Payload consists of the sensor suite, onboard controller, communications, and battery power pack. All communications between the platform and the control station passes through the mission payload.

The body shape and size of the aircraft is proportional to the size and weight of the maglev power drive which is determined by the cargo (batteries, remote control servos, cpu, and cameras).

VTOL UFOs use linear induction magnetic bearings (LIMB) which are ideally suited for propulsion where ~~as~~ they provide superior value compared to other traditional types (i.e. gasoline fueled engines and jet turbines). Value is a function of the following:

Lightweight: A LIMB power drive can weigh less than 1/20 of a conventional engine, part of which is lost through centrifugal force since most of the power drive is located in the propellerdisk (or impellerdisks).

High Reliability: With magnetic bearings there is no contact between the rotating and stationary parts, meaning there is no wear. These components have design lives far greater than that of conventional bearings and engines. Magnetic bearings are providing high reliability and long service intervals in time critical applications in semiconductor manufacturing, vacuum pumps, and natural gas pipeline compression equipment.

Clean Power: In a magnetic bearing system, polluting exhaust, particle generation due to wear and the need for lubrication are eliminated. There is no gas, oil, grease or solid particles.

High Speed Applications: The fact that a rotor spins in space without contact with the stator means drag on the rotor is minimal. that opens up the opportunity for the bearing to run at exceptionally high speeds, where the only limitation becomes the yield strength of the rotor material. Magnetic bearings have been designed with surface speeds up to 250 m/s or 4.5 million DN, where DN is the diameter of the rotor (mm) times the rotational speeds (rpm). In order to achieve one quarter of this kind of speed with conventional bearings, a complex lubrication system is required. No other type of bearing can match magnetic bearings for sheer speed. Magnetic bearings open new possibilities for extreme high-speed applications such as machine tool spindles

and turbo compressors.

Position and Vibration Control: Magnetic bearings use advanced control algorithms to influence the motion of the shaft and therefore have the inherent capability to precisely control the position of the shaft within microns and to virtually eliminate vibrations.

Extreme Conditions: The magnetic bearing system is capable of operating through an extremely wide temperature range. Some have applications as low as -256˚C and as high as 220˚C, thus allowing operation where traditional bearings will not function. Magnetic bearings can also operate in vacuum where their operation is even more efficient due to lack of windage.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1A is an exploded cut away perspective view of a single impellerdisk, embodiment of a VTOL UFO according to the present invention and **FIG. 1B** is the compiled cut away perspective view of **FIG. 1A**, showing the top of the fuselage (2), the propeller disk (1), the bottom of the fuselage (3), the vane assembly (4) and how they relate to each other.

FIG. 2A is an exploded cut away perspective view of a single impellerdisk, embodiment of a VTOL UFO according to the present invention and **FIG. 2B** is the compiled cut away perspective view of **FIG. 2A**, showing the top of the fuselage (2), the propeller disk (1), the bottom of the fuselage (3), the vane assembly (4) and how they relate to each other

FIG. 3A is a lower rear perspective view of a single impellerdisk, embodiment of an unmanned VTOL UFO according to the present invention. **FIG. 3B** is the top view of **FIG. 3A**. **FIG. 3C** is the bottom view of **FIG. 3A**. **FIG. 3D** is the side view of **FIG. 3A**. **FIG. 3E** is the rear view of **FIG. 3A**. **FIG. 3F** is the front view of **FIG. 3A**. **FIG. 3G** is an upper front perspective view of **FIG. 3A**.

FIG. 4A is a side view of a single propellerdisk, embodiment of a manned VTOL UFO according to the present invention, displaying the cockpit access ladder assembly (13). **FIG. 4B** is an upper rear perspective view of **FIG. 4A**. **FIG. 4C** is an upper front perspective view of **FIG. 4A**.

FIG. 5A is a lower front perspective view of a pair of joined propellerdisks, embodiment of a manned VTOL UFO according to the present invention, displaying a hoverboard configuration with a handlebar flight control assembly (21). **FIG. 5B** is the top view of **FIG. 5A**. **FIG. 5C** is the bottom view of **FIG. 5A**. **FIG. 5D** is the side view of **FIG. 5A**. **FIG. 5E** is the rear view of **FIG. 5A**. **FIG. 5F** is the front view of **FIG. 5A**. **FIG. 5G** is an upper front perspective view of **FIG. 5A**.

FIG. 6A is a lower front perspective view of a pair of joined propellerdisks, embodiment of a manned VTOL UFO according to the present invention, displaying a hoverbike configuration with a handlebar flight control assembly (21). **FIG. 6B** is the top view of **FIG. 6A**. **FIG. 6C** is the bottom view of **FIG. 6A**. **FIG. 6D** is the side view of **FIG. 6A**. **FIG. 6E** is the rear view of **FIG. 6A**. **FIG. 6F** is the front view of **FIG. 6A**. **FIG. 6G** is a side perspective view of **FIG. 6A**.

FIG. 7A is a lower front perspective view of a pair of joined propellerdisks, embodiment of a manned VTOL UFO according to the present invention, displaying a hoverpod configuration with a cockpit (14). **FIG. 7B** is the top view of **FIG. 7A**. **FIG. 7C** is the bottom view of **FIG. 7A**. **FIG. 7D** is the side view of **FIG. 7A**. **FIG. 7E** is the rear view of **FIG. 7A**. **FIG. 7F** is the front view of **FIG. 7A**. **FIG. 7G** is an upper rear perspective view of **FIG. 7A**.

FIG. 8A is a lower rear perspective view of three joined propellerdisks, embodiment of a manned VTOL UFO according to the present invention, displaying an aircraft configuration with a cockpit (14). **FIG. 8B** is the top view of **FIG. 8A**. **FIG. 8C** is the bottom view of **FIG. 8A**. **FIG. 8D** is the side view of **FIG. 8A**. **FIG. 8E** is the rear view of **FIG. 8A**. **FIG. 8F** is the front view of **FIG. 8A**. **FIG. 8G** is an upper front perspective view of **FIG. 8A**.

FIG. 9A is a lower rear perspective view of four joined propellerdisks, embodiment of a manned VTOL UFO according to the present invention, displaying an aircraft configuration with a cockpit (14). **FIG. 9B** is the top view of **FIG. 9A**. **FIG. 9C** is the bottom view of **FIG. 9A**. **FIG. 9D** is the side view of **FIG. 9A**. **FIG. 9E** is the rear view of **FIG. 9A**. **FIG. 9F** is the front view of **FIG. 9A**. **FIG. 9G** is an upper front perspective view of **FIG. 9A**.

FIG. 10A is a lower rear perspective view of five joined propellerdisks, embodiment of a manned VTOL UFO according to the present invention, displaying an aircraft configuration with a cockpit (14). **FIG. 10B** is the top view of **FIG. 10A**. **FIG. 10C** is the bottom view of **FIG. 10A**. **FIG. 10D** is the side view of **FIG. 10A**. **FIG. 10E** is the rear view of **FIG. 10A**. **FIG. 10F** is the front view of **FIG. 10A**. **FIG. 10G** is an upper front perspective view of **FIG. 10A**.

FIG. 11A is a lower rear perspective view of six joined propellerdisks, embodiment of a manned VTOL UFO according to the present invention, displaying an aircraft configuration with a cockpit (14). **FIG. 11B** is the top view of **FIG. 11A**. **FIG. 11C** is the bottom view of **FIG. 11A**. **FIG. 11D** is the side view of **FIG. 11A**. **FIG. 11E** is the rear view of **FIG. 11A**. **FIG. 11F** is the front view of **FIG. 11A**. **FIG. 11G** is an upper front perspective view of **FIG. 11A**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings wherein like reference characters identify corresponding or similar elements throughout the several views of the embodiments of the invention, **FIG. 1A and FIG. 1B** illustrate cut away perspective views, exploded and compiled, of one embodiment, using a single propellerdisk unmanned VTOL UFO according to the present invention. It includes a single propellerdisk (1), comprising of an outer discoidal ring (1a), and a series of propeller blades (1b) attached to the outer ring emanating from an inner hub ring (1c). The outer discoidal ring (1a) houses a permanent magnet ring (15b) used to levitate the propellerdisk a fraction of an inch from a permanent magnet ring (15c) in the fuselage (3). The outer discoidal ring

(1a) also houses the linear induction magnetic bearing (16) used to rotate the propellerdisk reacting to the linear induction actuator ring (17) in the fuselage. The outer discoidal ring (1a) also houses a ring of batteries or a custom battery ring (18) to power the linear induction magnetic bearing (16).

The inner hub ring (1c) houses three permanent magnet rings (15b) used to levitate the propeller disk a fraction of an inch from two permanent magnet rings (15a) in the top cap (2) of the fuselage and a permanent magnet ring (15c) in the fuselage (3). These permanent magnet rings (15a-c), which require no power, make up the bearing system needed to levitate the propellerdisk at all times including non-operation of the VTOL UFO.

The top cap of the fuselage, in this unmanned single propellerdisk embodiment, is made up of a tinted plexiglass dome and a bottom ring that houses the two permanent magnet rings (15a). The top cap (2) attaches to the center cone (3b) of the main body of the fuselage (3) to create the permanent magnet bearing system. The area within the top cap (2) and the center cone (3b) is the cargo area housing the central processing unit and battery assembly (9) and camera assembly (10). The central processing unit (9) controls all camera and flight control functions via a remote link to the linear induction magnetic bearing (16) and hard wire connections, emanating from the center cone (3b) through the hollowed struts (3a) connected to the inner wall of the outer toroidal fuselage (3), communicating with the linear induction actuator ring (17), the flight control stabilizer fins servos and batteries (6a and 7a), the rear vent servos and batteries (5), the bottom vane assembly servos and batteries (4b and 4e) and additional camera assemblies (11) all located in the toroidal fuselage (3).

The bottom vane assembly's outer ring (4d) is attached to the fuselage at the bottom opening of the toroidal duct. A servo (4e) rotates the inner vane ring (4c) and a second servo (4b) rotates at least one vane (4a, optional three vanes shown in drawings) to redirect the developed air flow in any direction. A rear vent assembly (5) is located at the rear of the toroidal fuselage to aid in forward thrust when opened. The VTOL UFO has at least two attached wings with pivotable portions (6 and 7), used for flight control, which are combined with the landing gear, pontoons or rails (8). An optional telerobotic arm (120 could be attached to the front of the fuselage for special

missions.

A ladder assembly (13) is demonstrated in **FIGS. 4A-4C** for entering the cockpit (14) of a manned single propellerdisk embodiment of the invention.

Another embodiment of the VTOL UFO demonstrates how multiple propeller disks can be joined by creating modular shrouded impellerdisks as shown in **FIG. 2.** The center cone (3b of **FIG. 1)** is eliminated placing the cargo areas/payloads in between the joined impellerdisks (19). Instead of the top cap (2) and bottom fuselage (3) joining in the center hub, they now join around the outside of the impellerdisks (1), which now has a closed hub, creating a toroidal shroud. Optional protective screens (20) can be added to the top and bottom openings of the toroidal duct.

Variations of multiple engine configurations with shrouded impellerdisks are demonstrated in **FIGS. 5A-G, FIGS. 6A-G, FIGS. 7A-G, FIGS. 8A-G, FIGS. 9A-G, FIGS. 10A-G, and FIGS. 11A-G.** Some of these ~~which~~ include foldable wing tips with pivotable portions (7) used for added flight control, joystick type flight controls (21), and/or cockpits (14).

In addition to the VTOL UFO embodiments described above, in accordance with alternate embodiments of the invention, scaled up and/or down versions of any of the embodiments heretofore described may be employed for recreational or surveillance purposes, whether or not human subjects are conveyed thereupon or being used as remote controlled UAVs. Such versions may be controlled by Standard Radio Controls.

The described embodiments of the invention are intended to be merely exemplary and numerous variations and modifications will be apparent to those skilled in the art. All such variations and modifications are intended to be within the scope of the present invention as defined in the following claims.